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Outsourcing new products development in conditions of technological uncertainty: partner selection criteria and project implementation mechanisms.

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Abstract

In knowledge intensive industries, an increasing number of firms rely on external knowledge sources and draw on the technical expertise of other firms to develop new products. Despite the dramatic increase in outsourcing, strategic activities such as New Product Development (NPD), few systematic studies on this topic have been carried out. We aim to provide an in-depth understanding of the criteria used by companies to decide to whom and how to outsource NPD in conditions of high technological uncertainty, from supplier's selection to project implementation. The findings emerging from 14 interviews with nine buyers and their supplier show that in addition to transaction cost economics and the resource based view of the firm, relational exchange theory, and co-creation theory help to explain outsourcing decision in NPD contexts. The balance of formal and informal mechanisms, namely trust and intellectual property rights emerge as the most important enablers of knowledge and information transfer in the implementation phase of outsourcing NPD.

Keywords outsourcing new product development; supplier selection; project implementation; transaction cost economics; resource-based view; relational exchange theory; co-creation theory.

1. Introduction

Modern firms need to innovate rapidly and cost-effectively in order to gain and keep a competitive advantage (Salge et al., 2012; Gesing et al., 2014), which makes it impossible for these firms to operate independently on their own along with being competitive (McIvor et al., 2006). These developments have fostered an increase in outsourcing strategic activities and meant that outsourcing has shifted its scope from focusing on peripheral activities such as cleaning, catering and security, to encompass more critical business value-creating activities such as design, manufacturing, marketing, and logistics (McIvor, 2009).

More and more firms, especially in knowledge–intensive industries, are faced with the need to rely on external knowledge sources and draw on the technical expertise of external partners to develop complex products in shorter periods of time (Lichtenthaler, 2011; Chesbrough, 2006; 2003; Laursen & Salter, 2006). Suppliers of NPD activities possess highly specialized knowledge about products and processes, which are often required to produce high quality products rapidly and at advantageous costs. Within this context, firms operating in knowledge–intensive industries such as pharmaceuticals, automotive, technology, and

consumer goods, are increasingly opening up their boundaries and searching for new external sources of knowledge (Calatone & Stanko, 2007).

Thus, externally contracting some NPD tasks has become a common practice among modern firms (Alguezaui & Filieri, 2011; Contractor et al., 2011; Stanko & Calantone, 2011). In this paper we explore strategic outsourcing (Holcomb & Hitt, 2007; McIvor, 2009), which involves the outsourcing of value-creating activities of a 'knowledge-intensive' nature such as NPD and industrial design, to external suppliers. The specific strategic focus of this study is NPD activities, which include the different stages of product concept design and analysis, assembly, testing, and manufacturing. For the purpose of this research, we refer to outsourcing innovation as crossing the boundaries of the firm via non-equity collaborations or contracting to obtain services, knowledge or processes that may support NPD. This may include co-developing or purchasing specialised new innovative technological knowledge.

Research has demonstrated that involving external suppliers can be beneficial to a focal firm (e.g. Handfield et al., 1999; Wagner, 2012); however, it can be also productive of negative outcomes (e.g. Wynstra, van Weele, & Weggemann, 2001; Van der Valk & Wynstra 2005). These mixed results suggest that involving the 'right' supplier and managing the collaboration process correctly is key when firms decide to involve suppliers in NPD process (Wagner & Hoegl, 2006). Critical decisions that firms must consider when they opt for involving external suppliers in NPD activities include supplier selection (Wynstra, Weggemann, & Van Weele, 2003; Petersen et al., 2005; Wagner, 2010) as well as the collaboration and governance mechanisms adopted to manage the outsourcing of NPD activities.

Despite the dramatic increase in outsourcing strategic activities such as NPD, few systematic studies on this topic have been completed (Holcomb & Hitt, 2007; McIvor, 2009) and the research question of which criteria to use to select suppliers for performing NPD activities has only recently received limited attention (Wagner, 2010; Hsuan & Mahnke, 2011). This study aims at fulfilling these shortcomings in the literature and attempts to answer the following research questions: *to whom* and *how should a firm outsource its new product development process*?

In order to provide an in-depth understanding of the outsourcing of NPD-related activities from supplier's selection to project implementation governance mechanisms, we have adopted an inductive approach based on qualitative technique and used in-depth interviews with managers (e.g. CEO, Chief Operations Officers, Chief Technology Officer) of nine buyers and a leading supplier providing full NPD service.

2. Literature review

2.1 Strategic Outsourcing

Outsourcing is an abbreviation for "outside resource using" (Quinn & Hilmer, 1994). Strategic outsourcing (SO) refers to the managerial approach to outsourcing in which firms rely on intermediate markets to provide specialized capabilities that supplement existing capabilities used in production (Holcomb & Hitt, 2007). Outsourcing innovation is a relatively new concept that has been extensively researched in the last two decades, yet is not

fully explained. Existing studies on this topic have mostly used Transaction Costs Economics (TCE) or the Resource Based View (RBV) of the firm to explain the outsourcing decisions.

TCE seeks to understand the effect that characteristics of a transaction have on governance costs (Williamson, 1975; 1979). In the outsourcing literature TCE has been used to answer the question of *why* to outsource, highlighting the role of *minimizing costs* as well as the *risks of opportunism arising from the governance of market exchanges* (e.g. Williamson, 2008). Adopting this perspective, outsourcing decisions are explained by a firm's need to reduce uncertainty, costs and opportunism when making outsourcing decisions. In particular, low degrees of asset specificity and uncertainty together with low risks of opportunism and costs reduction considerations, favour the decision to outsource to external suppliers.

The RBV assumes that companies outsource some or part of their production process to focus on their core capabilities as well as provide a means to acquire superior resources, knowledge, and competencies from external sources (Penrose, 1958; Barney, 1991). In this context, RBV theorists assume that a firm should focus on valuable, rare, imperfectly imitable resources that provide them with a unique competitive advantage (Wernerfelt, 1984; Barney, 1991; Lavie, 2006). RBV claims that heterogeneous resources resulting in unique and inimitable capabilities should be internalised while complementary capabilities should be sourced externally.

More recently, scholars have started to view RBV and TCE as complementary theories for explaining outsourcing decisions and have sought to integrate them. For instance, McIvor (2009) has emphasised the critical and complementary role of both TCE and RBV in the fields of business improvement and process re-design. However, both theories may not fully explain outsourcing decisions in the NPD context. On one side outsourcing decisions are not fully dictated by TCE considerations because costs considerations are no longer the primary concern for companies' seeking to outsource strategic activities (Ellram, Tate, & Billington, 2008; McIvor, 2009); while on the other side firms have started to outsource (sometimes even offshore), value-based activities, which can be source of competitive advantage (Contractor et al., 2011).

2.2 Outsourcing NPD

The existing literature on the analysis of supplier integration in NPD has produced contrasting results. Some scholars suggest that involving suppliers in NPD activities can lead to benefits including reduced costs, reduced development time (e.g., Clark 1989; Ragatz, Handfield & Scannell 1997; Petersen, Handfield & Ragatz, 2005), improved product manufacturability, better product quality (McGinnis & Vallopra, 1999; Handfield et al., 1999; Primo & Amundson 2002; Ragatz et al., 2002; Petersen et al. 2005), and improved design-for manufacturability (e.g., Wasti & Liker, 1997, Swink, 1999); while others have highlighted the drawbacks of involving suppliers in NPD (e.g. Laursen & Salter, 2006; Wynstra, van Weele, & Weggemann, 2001;Ciravegna & Maielli, 2011; Zirpoli & Becker, 2011; Salge et al., 2013).
The mixed results in the literature on supplier involvement in NPD suggests there is a need for a more in-depth approach to studying outsourcing innovation decisions, as well as further exploration of the problems firms face when they involve suppliers in the NPD and how they try to deal with them (Wagner & Hoegl, 2006). Some academics have started to address these issues and identified stages in the 'outsourcing decision making process' (McIvor, 2000;

Franceschini et al., 2003; Van Weele, 2005). For instance, scholars commonly recognize two critical decisions that firms must perform in the innovation outsourcing process: *supplier selection* and *implementation or management* (Wynstra, Weggemann, & Van Weele 2003; Petersen et al., 2005; Wagner, 2010). In this study we focus on the outsourcing of the NPD process and seek to understand how firms choose among suppliers (*supplier selection*) as well as how they manage their outsourced NPD-related activities (*implementation*). The *selection stage* refers to the time frame when the firm recognizes the importance of outsourcing, identifies, and evaluates which parts of the innovation process to outsource and chooses the outsourcing partner or the service provider and its location. On the other hand, during the *implementation stage*, the firm creates the processes and structures deemed to be necessary for successful outsourcing. Below we discuss the literature referring to both stages of the outsourcing process.

2.3 Supplier Selection: To whom to outsource NPD activities?

A key strategic decision in the outsourcing of the NPD process is the selection of an appropriate provider. Selecting the right supplier can have a significant impact on the effectiveness of a NPD team (Petersen et al., 2005). There are different criteria that the buyer needs to take into consideration when selecting from a pool of potential suppliers. TCE and RBV are the theories that have been mainly used to explain partner selection in the outsourcing literature (Holcomb & Hitt, 2007; Hoegl & Wagner, 2005). However, the main component of TCE is the firms' concern on costs, which nowadays have become a less critical factor in selecting a supplier especially under situations of high technological uncertainty (Ho et al., 2010).

The proponents of the RBV have shown that an increasing number of firms select partners that allow them the access to their superior resources (Odagiri, 2003; Howells et al., 2008). By the same token, outsourcing innovation can involve the externalization of core capabilities (e.g. knowledge-generating activities), which contradicts the assumptions of RBV proponents in terms of internalising the firm's core competencies (Alguezaui & Filieri, 2011).

Studies in marketing, strategy, and innovation claim that the most important factors in supplier selection are related to: the supplier's characteristics in terms of geographical proximity (Schiele, 2006); competence in mastering a new or complex technology; supplier innovation potential (Wagner & Hoegl, 2006); technical and commercial performance measures and targets (Petersen et al., 2005); collaboration history (Kale & Zollo, 2006; Rundquist, 2008); and having 'good enough' knowledge that can resolve specific problems (Rundquist & Halila, 2010). The capabilities of a supplier of NPD should match the buying company's needs (Petersen et al., 2005).

Under conditions of high uncertainty though, it has been demonstrated that the supplier's ability and willingness to cooperate are much more important than the technological competency (Tyler, 2001). Along the same vein, Rundquist (2008) found that firms tend to outsource their NPD activities to suppliers with close ties that they have a previous history of relations with, rather than those with 'world class' knowledge or strategic resources. According to Hoetker (2005) the role of capabilities, past relationships, and being an internal or external supplier is contingent upon the level of uncertainty of the desired innovative component. Hoetker's (2005) study suggests that when uncertainty of the desired component is low, the differences in supplier's technical capabilities seem to be the primary basis to

make a decision regarding to whom to outsource. However, as uncertainty increases, *prior relationships* and a *supplier being internal* become relatively more important than the technical capabilities (*ibid.).* Additionally, other scholars stress the importance of assessing *long-term orientation* of the supplier as it enhances collaboration under technological uncertainty (Emden et al., 2006). In view of this literature, it is evident that few studies have attempted to provide an in-depth understanding of partner selection criteria in outsourcing NPD decisions (Wagner, 2010; Hsuan & Mahnke, 2011). Thus the first research question of the study is:

RQ 1 - How do buyers select suppliers when outsourcing NPD activities?

2.4 Supplier Management: how to outsource NPD activities

Outsourcing innovation requires efforts to constantly and continuously coordinate the activities between the supplier and the buyer. Formal mechanisms, mainly contracts, are utilised for protecting a firms' proprietary intellectual property; whereas informal mechanisms, mainly trust and norms, contribute to building strong relationships.

However, mutual trust or informal mechanisms do not always guarantee trustworthy behaviour and coordinated actions among partners (McEvily et al., 2003); therefore, *governance mechanisms* are critical when effectively sourcing innovation from external partners. Governance mechanisms include the approaches and mechanisms used to manage inter-firm collaborations. Identifying the most effective governance mechanisms in outsourcing is paramount because it helps explain the success of NPD projects in buyer-supplier collaborations (Hoegl & Wagner, 2005).

According to Wagner (2010), research should focus on the soft facts and human issues involved in people interactions from two organizations. Thus, there is a need for the conceptualization and analysis of supplier integration at the project level, which may include factors that could contribute to explaining successful and unsuccessful collaboration in outsourcing innovation projects (Wagner, 2012).

Studies on the success factors of outsourcing innovation have focused on the composition of the project team (Wagner & Hoegl, 2006), task coordination gaps (Gerwin, 2004), specific communication and collaboration mechanisms (i.e. Hong & Hartley, 2011; Bhalla & Terjesen, 2013), or the quality of the collaboration between the buyer and supplier team members (Hoegl & Wagner, 2005). Gerwin's (2004) theoretical model suggests that an important factor contributing to the success of joint NPD projects is reducing the coordination gap among the collaborative partners. Mismatches between the required and actual coordination of tasks have a negative impact on the performance of a NPD project (Gerwin, 2004). Commitment is also regarded as a necessary and sufficient condition as commitment enhances the cooperative behaviour within inter-firm relationships and is the most important factor influencing performance and also has beneficial implications within inter-firm relationships as it enhances cooperation and financial performance as well as reduces relationship termination and conflict (Liu et al., 2010).

Hoegl and Wagner (2005) reveal that strong buyer-supplier collaboration is positively related with development schedule and development cost efficiency as well as product cost and product quality effectiveness for product development projects, while increases in

communication frequency and intensity have a curvilinear (inverted U-shaped) relationship with project development budgets and product costs. In a subsequent qualitative study, Wagner and Hoegl (2006) report that at project level, team members' compatibility, complementarity technical competence, and communication are the most frequently mentioned success factors related to project staffing.

Similarly, in a quantitative study of customer-supplier new development projects Wagner (2010) concluded that downstream customer orientation and supplier-customer homophily have a significant impact on the customer firms' NPD efficiency (i.e., project cost and project speed) and effectiveness (i.e., innovativeness). More recently, Bhalla and Terjesen (2013) use a qualitative approach to investigate the competencies that new firms must possess to realize benefits from outsourcing competencies in the biotechnology industry. Narrative interviews enabled them to identify integration process facilitators, which included: working jointly, seeking understanding, and addressing conflicts and failures in early stages.

In the current study, we seek to contribute to extant literature by investigating and exploring effective governance mechanisms in buyer-supplier relationship in the context of NPD-related activities and answer the following research question:

RQ 2 - How do buyers manage their relationships with suppliers when they outsource NPD activities?

3. Methodology

The aim of this study is to analyse two stages of the NPD outsourcing process: supplier selection and its subsequent management. A qualitative case study method was selected because the phenomenon under investigation is new and it is hard to find similar research and business cases (Eisenhardt, 1989). We adopted the procedure proposed by Eisenhardt (1989) for handling a qualitative analysis: *define the content of the analysis*, *select relevant cases*, *analyze the collected data*, and *discuss the implications*.

With regard to the *content*, the focus of the study was to understand the partner selection process and the governance mechanisms adopted to manage the outsourcing process in the context of NPD.

In relation to *selecting the relevant cases*, case studies can involve either single or multiple cases (Yin, 2003). We adopted the multiple case study approach, where numerous cases are used to analyse the phenomenon, as it can be used to answer our research questions and inductively develop theory. Multiple case studies are mainly used to accomplish the following research goals: "(1) predicts similar results (a literal replication) or (2) predicts contrasting results but for predictable reasons (a theoretical replication)" (Yin, 2003, p. 47). Our unit of analysis was thus a dyadic buyer–supplier relationship involving outsourcing NPD projects.

In relation to *the rationale for selecting the cases* we focused on a supplier that have received awards and is pioneer in offering full NPD services in the UK (Tharsus Ltd). Tharsus has over 200 employees and has recently received several awards including for Mechanical Engineer Manufacturing Excellence, lean manufacturing, green technology innovation

(Rushlight Awards), and was named best SME of the year 2012 in the UK. The company has also been selected for its advanced collaborative product development approach. Clients of the company include the likes of 3M, ITM Power, Safety Kleen, and others.

In relation to the buyers, the selection was undertaken together with the main contact personal at Tharsus. The rationale for selecting buyers was based upon two criteria: 1) the supplier's previous and new customers (ongoing collaborations); 2) both successful and unsuccessful collaborations.

By adopting a multiple case study approach, we are able to highlight the potential similarities and variations among the selected case studies (e.g. varying degree of success including successful versus unsuccessful outsourcing projects) in relation to supplier selection criteria and governance mechanisms when outsourcing NPD activities.

The qualitative approach was preferred in this case as we aim to explain the how and why of the phenomenon under investigation (i.e. why suppliers are selected for NPD activities and how the collaboration is governed).

Semi-structured interviews were used where interviewees were first informed about the general purpose of the study, the data treatment and storage, and ethics approval. In total, 14 in-depth interviews with representatives of nine buyers and one supplier were conducted either face-to-face or on the telephone over a period of 4 months. Table 1 illustrates the profile of participants.

The interview template included the following sections: interviewee (e.g. position and job history) and company profile (e.g. number of employees, industry sector, and former and actual collaborations involving suppliers in NPD); motivation for outsourcing NPD; reasons for selecting an outsourcing partner; discussion of the degree of uncertainty in the industry and technology relating to NPD; criteria for partner selection and discussion of the importance of each (in general); application of the selection criteria to the outsourcing partner; governance mechanisms adopted to manage the outsourcing project; problems (if any) that emerged during the collaboration; discussion of ways to improve the collaboration in the future; innovation outcomes and overall evaluation of the outsourcing supplier.

The length of interviews varied from 36 to 97 minutes, and the average interview length was 61 minutes ad data were analysed using thematic analysis (Braun & Clarke, 2006).

Yin (2003) proposes a combination of different sources of *evidence* for data collection (data triangulation). Therefore we collected information from several sources including interviews with the selected supplier and former and actual buyers, written and electronic information regarding Tharsus and its buyer clients, archival resources, direct observation, articles in newspapers, magazines, and other publications.

To ensure construct validity and reliability, individuals with different roles and from different organizational levels in the selected supplier were interviewed (e.g. marketing & sales, R&D, operations, management). The findings emerging from the data analysis were checked with key informants, and final results incorporated feedback from both formal and informal meetings with the supplier, workshops involving industrial suppliers, and academic conference presentations.

Table 1.
Profile of firms and interviewees

ID	Position	Employees	Industry	Customer Type
1	Technical Project Manager	0-50 employees	Remote Tyre Pressure &Condition Monitor.	Prospect
2	Head of Operations	0-250	Energy storage systems	Ongoing collaboration
3	Engineering Manager	0-80 employees	Innovative technologies for the environment , industrial backup power	Successful collaboration
4	Project Manager -Mechanical Engineering	0-250	Management and control of energy systems. They design Turbo machinery. Oil and gas industry	Prospect
5	Chief Executive Officer	0-50	Technology for the Environment	Ongoing collaboration
6	Technology Director	0-100	Clean Tech (green hydrogen transport fuel)	Successful collaborations
7	Director	0-50	Technology for the Environment	Unsuccessful collaboration
8	Chief operations officer	> 6.000	Logistics	Ongoing collaboration
9	Chief technology officer, director	0-250	Clean-tech	Successful collaboration
10	Sales manager, marketing manager, chief technology officer, chief operations officer, CEO	Tharsus Ltd., 0-250 employees	Manufacturing and design mainly in the clean-tech industry	

4. Research Findings

4.1 Research Question 1 – How do buyers select suppliers when outsourcing NPD activities?

Our results indicate that in addition to TCE and RBV, relational exchange and co-creation theories also contribute to explaining supplier selection when outsourcing NPD activities. Table 2 summarises our findings regarding supplier selection and project implementation.

4.1.1 Transaction Cost Economics factors

4.1.2 Production costs

Production costs refer to the costs of actually manufacturing and delivering goods and services, which differ from one company to another (Alchian & Demsetz, 1972). Production costs discussed by interviewees include the cost of design or manufacturing or both. This is one of the most basic and straightforward criterion used to select a supplier.

> *"Again, something that is attractive if someone comes along and says it's going to cost £150,000 to design it, we would have thought very hard. But as it is, the cost is being amortised over quite a few units over the next couple of years, so that's another attractive part of it."*(Company 5)

4.1.3 Coordination costs

Coordination costs refer to the costs of controlling and monitoring vendors when outsourcing goods or services (Alchian & Demsetz, 1972). Most of the time, firms prefer a long-term relationship with their suppliers as changing partners generates additional coordination costs. Coordination costs arise from the need to define, negotiate and enforce contracts, as well as to monitor and coordinate activities across organizational boundaries (Alchian & Demsetz, 1972). This is especially the case for firms operating in high tech industries where inter-firm coordination mechanisms take a longer time to establish and are tailored to a specific relationship (Dyer, 1996). Our findings highlight that buyer companies often seek a stable and long-term collaboration when outsourcing NPD, thus they favour companies that are known to have financial and managerial stability.

> *"We are obviously looking for a long-term relationship so we need to be working with a company that has stability, financial stability, management stability and again, I think – I've not seen the accounts of the company but I think we've got a partner here that is in it for the long haul, and not looking at a short-term, quick buck and out."* (Company 5)

4.1.4 Delivery lead-times

Delivery lead-time has been identified as the second most important criterion for supplier selection after quality (Ho, Xu, & Dey, 2010). Delivery time is particularly important since delays in delivery may have negative consequences on the buyer, especially in high-technology industries, which are characterized by complexity and highly interdependent relationships between the different components and suppliers. Delays in delivering one component may generate higher costs by delaying the whole NPD process, increasing the buyer's coordination costs with other members of its value chain, and generating opportunity costs such as those related to speeding up delivery.

> *"Also were looking at lead-time as well, so time to deliver the work, whether it's an item or whether it's a bit of design work."* (Company 4)

5. Resource-Based View Factors

5.1 Complementary nature of supplier resources and capabilities

Our results suggest that the most important criteria used to evaluate supplier capabilities is their ability to fulfil a NPD task in an efficient and effective manner. Therefore, gaining access to the key knowledge and specific capabilities needed to solve a problem or an issue facing the focal firm is important when outsourcing innovation (Hoetker, 2005; Rundquist & Hatila, 2010).

Interviewees also shed light on the importance of the *complementary capabilities* shown by a supplier during the selection process that fits the buyer needs. The identified supplier, for instance, could offer design, R&D, and manufacturing competencies to the buyer. According to respondents, the supplier was selected because they complemented the in-house capabilities and resources of the buyer, making them a complete company according to some interviewee's words. Another interviewee described the supplier as being the manufacturing unit of his own company. The quality and complementary characteristics of the supplier's

resources and capabilities were important factors when selecting a supplier and especially for building long term relationships.

Obviously our key core competence is sales and marketing, and I'd like to think product support. That's not what Tharsus do. They do the R&D and the manufacture. So, in that sense, we absolutely complement each other. If we got together we could be a complete company." (Company 5)

5.3 Absorptive capacity

Absorptive capacity is the ability to value external knowledge, to assimilate it, and to commercialize it, depending on the similarity of both firms' knowledge bases (Cohen & Levinthal, 1990, p.128). The findings of this study show that the capability to listen and understand the problem and challenges faced by the buyer in an important criterion to secure outsourcing NPD projects.

'These guys are different, they will listen, they'll soak up ideas where they can and that is very important.' (Company 4)

'good, capability to very rapidly understand what it is you're trying to do.' (Company 8)

5.4 Quality

Quality emerged as the most recurrent criterion for suppliers' selection following a systematic review of the literature (Ho, Xu & Dey, 2010; Le Dain, Cheriti & Calvi, 2011). Quality is an abstract multi-dimensional concept that changes according to buyer needs (Lai, Yeung and Cheng. 2012, Flynn, Schroeder, & Sakakibara, 1994) and embraces the key concepts of product quality, system quality, quality improvement and total quality management (Hong and Hartley 2011; Lai & Cheng, 2003; Hoegl and Wagner 2005). Our results highlighted that when outsourcing NPD, buyers seek a supplier with quality management capabilities that views quality as critical strategic issue, not just an operational one (Malik et al 2012). In this case study the supplier had ISO 9000 certification, but had also development systems for linking quality improvement with the needs of buyers within a quality management framework in a similar manner to those described by Yeung, Cheng, & Lai (2005).

Quality, cost and flexibility really are most important criteria for selecting partners… So, you know, how much – three key areas, price, quality and the in-house capacity." (Company 1)

6. Co-creation

In a business to business context, value co-creation is subjective and depends on context and nature of buyer-supplier relationships (e.g., Corsaro, Fiocca, Henneberg, & Tunisini, 2013; Natti, Pekkarinen, Hartikka & Holappa, 2014). Co-creation as a joint activity has been frequently researched in dyadic relationships (Grönroos & Voima, 2013, Hakanen & Jaakkola, 2012; Hjelmgren & Dubois, 2013). The results of our study indicate the importance of a supplier co-creating value with the buyer by for example working together on NPD

design. A supplier that has a capacity to co-create, and specifically, co-design, the product with the buyer was preferred.

The participants in this study all mentioned that excellent design and manufacturing capabilities critically influenced their decisions to outsource innovation. Unique capabilities to integrate both design and manufacturing capabilities as well as to be able to provide relevant and substantial insights at an early stage of NPD were important and helped the supplier understand the knowledge generated by buyers and smoothly translate a design into prototype and then manufacturing process. Design was thus co-created during the early stages of the NPD process, which provided opportunities for addressing issues effectively (e.g. design a prototype effectively for scalable manufacturing).

> *"we have found that they listen, whereas the experience with the last lot was that they knew it all and there's little bit of that, what engineers- a trap engineers fall into which is what I call the "not invented here" syndrome. So if they haven't thought of it themselves then it's absolute rubbish. These guys are different, they will listen, they'll soak up ideas where they can and that is very important."* (Company 5)

7. Relational exchange theory factors

7.1 Competence-based trust

Competence-based trust can be defined as the buyer's belief in the supplier's skills and technical capabilities to accomplish the project's goals and deliver to a predefined set of standards (Mayer et al., 1995). Interviewees highlighted the importance of competence-based trust in mitigating the risks of the buyer rejecting the knowledge coming from suppliers, namely the *"not invented here"* syndrome; enhancing then the buyer's willingness to integrate the supplier's views and knowledge even at an early stage of the relationship.

Such judgement of supplier competence is deduced from the past experiences of the supplier to deliver similar projects as well as their reputation within the industry in terms of: levels of expertise in relevant knowledge domains; quality of capabilities, and soundly diversified resources. Other buyers developed their competence-based trust through personal experiences as well as initially testing and evaluating supplier capabilities using simple and risk-free tasks.

> *"I mean, there's a reason that he would be down to things like collaboration. So, from the conversations I've had with them so far, they're easy to work with, come across as open and honest in terms of dealings, capability and proven history of delivering similar kinds of products. So it's basically we trust them because they can deliver, they have the capabilities, the skills to deliver at the standard that you require. I think that succinctly puts it…Very important. Trust, and being able to work with them, is probably one of the key things. …. "* (Company 4)

7.2 Integrity-based trust

Another type of trust emerging from interviews is integrity trust, which is defined as the trustor's perception that the trustee adheres to a set of principles that the trustor finds acceptable (Muthusamy & White, 2005). Integrity-based trust can also be referred to the extent to which a trustee is believed to adhere to sound moral and ethical principles, and can

be equated with fairness, justice and promise fulfilment (Colquitt et al., 2007). Integrity trust in the high-tech sector is particularly important because the first-mover in a new technology area can gain a competitive advantage. Our interviews suggest that some buyers provide a supplier with nothing more than a patent or a new idea or solution which represent the core value or the most important asset of many of the companies in our study. It is then apparent that in a context characterised by high uncertainty, the assurance that these ideas and knowledge will not be disclosed to a third party is critical in supplier's selection.

> *"It's trust based on integrity. I mean, we, at the moment, are still putting together the manufacturing agreement. So we have a Heads of Terms, which is about a page and a half or something like that, so we don't actually have a piece of paper that ties everyone down to exactly where they need to be. So right now it's based on trust, which is- we believe in their integrity and I'd like to think that they believe in our integrity. And they made it very plain that they would never have got into bed with us if they didn't feel comfortable that they were working with people that they could trust, get on with, work together with, or key things."* (Company 5)

7.3 Affect-based trust

Affect-based trust refers to 'the extent to which a trustee is believed to want to do good to the trustor, aside from an egocentric profit motive' (Mayer et al., 1995, p. 719)), namely it is the belief in the other party's good intention to perform as agreed without behaving in an opportunistic manner. Affect-based trust is based on the impression that the buyer forms about the supplier during their initial interactions. Interviewees from different buyer firms highlighted the role that supplier trust and openness played as indicators of the good intentions and the benevolent sense of the supplier. In addition, the buyer's trust in the good intentions of the supplier might increase the willingness of the buyer to undertake some risky activities and to share their internal knowledge at an early stage of a project.

> *Trust is just about the most important thing there is and one of the reasons why we went with Tharsus …I work with my suppliers I trust my suppliers. We have open working relationships with suppliers. If you don't have that we can't basically progress the product anywhere near as well is what we could do.* (Company 9)

8. Research Question 2: How do buyers manage their relationships with suppliers when the outsource NPD activities

8.1 Balance of Formal vs. Informal governance mechanisms

With regards to relationship management, our findings show that buyers opt for two main mechanisms to govern the relationship with a supplier in NPD projects: trust and IP rights agreements.

8.1.1 Formal governance mechanisms: Intellectual Property (IP) rights agreement

Since individual firms pursue their own interests when dealing with others there is a risk that they may act opportunistically. Therefore, it is important to ensure that both firms and exchange partners behave in a predictable and stable manner (Williamson, 1985). By providing mutually agreed standards of behavior, formal governance obviates private incentive seeking, promotes partnership confidence, and thus engenders greater commitment in interfirm exchange (Lee & Cavusgil, 2006). One of the most important formal governance mechanisms are contractual agreements, which specify the roles and responsibilities of each party, stipulate courses of action during unforeseen circumstances, and state the major objectives to be achieved (Poppo & Zenger, 2002). Based on our interviews, the most important contractual aspect in buyer-supplier relationships are IP rights which establish the ownership of any new knowledge or new product emerging in interfirm relationships. In context of technological uncertainty as in our case study, IP rights seem to be particularly important.

"Yeah, if what we're working on is not protected, then that means we can't share anything until it's protected, which can cause a barrier, a delay. So there's that. The necessity of getting agreement like NDA and those kind of thing takes time. So they're usually a bit of a barrier. They're an essential thing, but they're a barrier in many ways too. ... Our business is all about IPs so, where very strict on what we will give away and what access, to our IP, people have. ...we just make prototypes, so all of our business is centred around development, generation of IP." (Company 4)

8. 2 Informal governance mechanisms: Trust

We have discussed above about the different facets of trust. Below, the findings highlight how trust is an important factor also in the implementation phase.

"There's a very high level of trust in our business from engineering up to director level." (Company 8)

8.2.1 Open, Frequent, and Continuous Communication

Our results suggest that one of the most effective mechanisms for managing an outsourcing the lifecycle of a relationship with a supplier in NPD projects is *open, continuous, and frequent communication* efforts aimed at effectively sharing information and knowledge related to the project. Specific buyers established various tools to keep the communication between their internal departments and the supplier constantly flowing at every stage of the NPD process. They emphasised that a timely and open exchange of information with the supplier is a key metric to evaluate the performance of a NPD project. Such effective mechanisms for knowledge sharing facilitate further development of trust as both parties are aware factors such as costs and tasks in progress at all times. It has also set the scene for cultivating a problem solving culture that can tackle any issues that may be encountered as soon as they are detected. Some of the mechanisms that have been adopted include: the development of committees co-involving personnel from both companies and from different business areas; organising frequent meetings and information exchange sessions for progress

updates; enabling formal and informal means of communication (e.g. ad hoc direct calls to engineers without having to go through project manager); using different channels (e.g. on-site visits, phone calls, emails, skype calls etc.), and exchanging documents and reports on time.

> *"I think it's got to be, sort of, open communication is very key to me. You know, when we place an order we're able to track what's going on and the progress of that order. And, yeah, make sure that the processors are put in place to ensure the quality where it's, you know it's key to making sure that the processes are developed and put in place from the start to make the quality good…It needs to be communication at the right level with the right people, and on a regular basis really."* (Company 1)

8.3 Commitment

Another important indicator of good collaboration identified by our analysis of the interviews is both buyer and supplier commitment. Commitment is defined as a continuing desire to maintain or develop a valued relationship and integrates the intention and expectation of continuity with the willingness to invest resources in the relationship (Liu et al., 2010). Interviewees have clearly stressed the importance of both parties' willingness to proactively engage in the relationship and contribute to success of NPD projects. Supplier commitment is manifested through the efforts, time and resources that the supplier invests in maintaining and nurturing the relationship. Commitment is crucial for guaranteeing long-term collaboration and generating financial and relational gains for all parties as it enhances trust and intimacy among partners and reduce the potential risk of conflict, enhancing knowledge sharing at all levels.

> *"So therefore that's why I come back to it, its that seeing that the people that you're working with are doing it not just for the money. It's very, very important, certainly from our point of view that they're almost taking a stake in our business. You know, so it's almost that– that's what I'm saying is, and I believe the way that Tharsus would see working with us is that they'd be actually taking stage in our business and the better job they can do, the more products we sell, the more business they get. And that's where it's sort of based down towards rather than just give us more cash, you know."* (Company 3)

Table 2.

Summary of findings

	TCE	***RBV***	***Co-creation***	***RT***
Factors affecting supplier selection	1)Production costs 2)Coordination costs 3)Lead-times	1)Complementarity and uniqueness of supplier's resources and capabilities 2)Absorptive Capacity	Co-design	1) Competence-based trust 2) Affect-based trust 3) Integrity-based trust

		3)Quality		
	Formal mechanisms		***Informal mechanisms***	
Factors affecting outsourcing project implementation and knowledge transfer	1) NDA and IP rights agreement		1)Trust 2)Commitment 3)Open, frequent and continuous communication	

9. Discussion

Scholars have called for a combinative approach to studying the complex phenomenon of strategic outsourcing that crosses theoretical disciplines (Hatonen & Eriksson, 2009). In this paper, we explore the complex process that firms go through when selecting a potential partner to outsource their innovation-related activities. Our findings highlight the criteria that buyers perceive as important when evaluating potential suppliers and managing NPD outsourcing relationships.

Our results suggest that in conditions of high technological uncertainty, a buyer firm elects a supplier to perform NPD activities and processes using criteria that have previously been explained using four separate theories: TCE, RBV, co-creation, and relational exchange theory. In this study we identify factors that link these theories and by doing so help explain supplier selection and relationship management when outsourcing NPD. These factors include: the costs linked to production, coordination, governance and delivery lead times (TCE factors); the capacity to co-design and to provide inputs (co-creation); the expected quality of outputs, and complementarity of the supplier's resources and capabilities (RBV), as well as the willingness to take a risk and the different types of trust (relation exchange theory).

Drawing upon the results of our research, we can conclude that suppliers that deliver on time, help reduce coordination, governance and transaction costs; have complementary as well as heterogeneous capabilities; are capable of understanding the entire NPD process and are able to add value to it; as well as show commitment, competency, reliability, and honesty will be preferred as outsourcing partners for the development of new products. Our findings show that under high levels of technological uncertainty, firms select knowledgeable and competent suppliers rather than lower cost suppliers which is agreement with previous studies (Hoetker, 2005; Koufteros et al., 2007; Rundquist & Hatila, 2010). More specifically, knowledge and an understanding of the entire product development process seem to be

particularly important when evaluating potential suppliers in the context of outsourcing NPD in conditions of technological uncertainty.

An interesting finding is the relational view appears to provide a solid theoretical foundation for analysing the factors that influence partner selection when outsourcing innovation. Many companies are increasingly outsourcing and sometimes even offshoring value-generating activities and processes of a 'knowledge-intensive' nature (i.e. R&D) as well as core capabilities (e.g. Martinez-Noya & Garcia-Canal, 2012), which entails a high degree of appropriation risks associated with opportunism and uncertainty. Interfirm relational exchange theory as well as co-creation theory both provide a framework for the focal firm to choose the right partner/supplier. This result is particularly important as it shows that companies are increasingly looking for trusted partners when outsourcing value-generating NPD activities. We show that due to the uncertainty inherited in the process of developing new products and the novelty of knowledge and technologies involved, it is very difficult to evaluate a supplier before the start of a project based on the conventional criteria of costs, resources, and capabilities. Instead, firms develop perceptions of the integrity and competence of a supplier and assess their co-creation capabilities in an effort to predict the behaviour and ability of suppliers to accomplish NPD goals and tasks in the best possible way.

Buyers focusing on the outsourcing of NPD activities choose suppliers that they trust because of their competences, integrity and benevolence. Both competence and integrity-based trusts are derived from a rational judgment; while affect-based trust reflects more subjective and emotional beliefs towards the supplier (Mayer et al., 1995). The former types of trust are calculative and based on rational assessments of the supplier's ability and track record including their: reputation within the industry; conduct; past experience with the buyer; history to deliver similar projects to the standards needed, and the like.

Our results suggest that even though affect-based trust is more subjective, it can be a pivotal factor that the buyer considers when selecting a supplier, confirming the results of previous studies (Das & Teng, 2001). Accordingly, affect-based trust reduces the perceived risk that the supplier will behave in an opportunistic manner; and opens doors for cultivating a basis for an open and collaborative relationship, enhancing knowledge flows and idea sharing earlier on, and increasing the supplier's willingness and commitment to fulfil their agreement (Sengun, 2010; Das & Teng, 2001).

Our findings confirm that competence and integrity based trust complement and reinforce each other in the supplier selection process. This is particularly important in high-tech industries where the quality (degree of innovativeness) and efficiency (time and cost to innovate) of innovation is highly valued. For instance, competence-based trust facilitates the extent and efficiency of learning among firms by enhancing their potential absorptive capacity (Luo, 2006). Competence-based trust plays a significant role in the supplier selection process as buyers need to be confident that the supplier will be able to deliver the objectives of the project efficiently and effectively and overcome any challenges related to creative processes. In addition, competence-based trust enhances the buyer's belief that the supplier is able to adjust to ever changing needs in the market. Integrity-based trust is also important especially in contexts where knowledge is not yet clearly defined and time to market is important. High levels of integrity-based trust will minimize barriers associated with accessing knowledge at an early stage, reduce the need for writing a detailed contractual

agreement, and mitigate the risks associated with the leakage of the buyer's unique knowledge to other companies.

In view of the complex role played by this multi-dimensional concept, we recommend that future research should consider the influence played by each dimension of trust when outsourcing innovation. Based on our results we agree with Sengun's (2010) proposition that trust *per se* does not guarantee inter-firm learning and that it is the type of trust that matters.

In relation to the *implementation stage*, previous studies have highlighted the importance of relational factors including trust in governing the relationship between buyers and suppliers supporting the findings of research focussing on inter-firm contexts (e.g. Thorgren & Wincent, 2011; Caniels, Gelderman & Vermeulen, 2012; Ford et al., 2012). However, in this study we have stressed the complementary nature of formal mechanisms, such as IP rights contracts, which are utilised to protect a firms' proprietary intellectual property, as well as informal mechanisms, such as trust, commitment and communication quality when outsourcing NPD. This finding confirms the results of a study that explored enablers of knowledge transfer in China that concluded that trust and contracts have a positive joint effect (Zhang & Zhou, 2013).

In this paper, we have investigated the role of trust before and after the establishment of the outsourcing relationship. Our findings suggest that trust between the buyer and potential supplier can be exhibited in different forms based on either subjective (affect-based) or more rational (integrity and competence-based) assessments. The combination of these three different types of trust provides a solid foundation for developing strong relationships. This relationship development is reinforced by quality (open and accurate), as well as the frequency of communication and other coordination mechanisms that can be put in place to facilitate knowledge sharing and mutual learning between the supplier and its buyer. Openness of communication also has a crucial role as it helps partners to discus difficult situations and resolve conflicts easily and quickly without having to escalate them to higher management. Our results suggest that the preliminary forms of trust between the buyer and its supplier, especially competence and integrity-based trust, facilitate the generally tedious and lengthy process of contracting, increasing efficiency, and enhancing open and frequent communication. Effective coordination mechanisms, in its turn, facilitate cooperation and knowledge sharing, which subsequently results in the development of more relationship specific trust and mutual commitment.

Our results also show that there is a reinforcing relationship between formal (e.g. IP rights, NDA-Non Disclosure Agreement) and informal governance (e.g. trust, commitment) mechanisms when outsourcing NPD. In our case study the supplier created favourable conditions by giving away a potential opportunity to own IP rights to buyers, but by doing so created a trustworthy relationship. The innovative nature of NPD projects in our study, means it is very difficult to develop IP agreements that includes all contingencies and specifications because the knowledge and the related competences emerging from any collaboration are not usually known at the start of a collaborative project and thus they cannot be detailed in written agreements. There is however a very good level of trust and commitment that makes the buyers feel safe that the supplier will not behave in an opportunistic way. These conditions, in combination with effective communication mechanisms, contribute to facilitating the transfer of knowledge and information which is fundamental in the implementation stage of outsourcing NPD. Thus, formal and informal mechanisms complement each other when outsourcing NPD projects as both mechanisms contribute to a

healthy relationship. Our findings highlight that communication is important in the implementation of an outsourcing project, which is consistent with the results of previous research (Hong & Hartley, 2011; Hoegl & Wagner, 2005, Tuten & Urban, 2001).

10. Limitations and future research

This study has some limitations. First, due to financial and time constraints, the selected companies and supplier were all located in the UK with most participating buyers operate in the clean-tech industry. Future research should consider a more diverse sample and conduct a similar study in different countries than UK. Our study was based on the development of new products in conditions of high technological uncertainty. The replication of the study in another context, such as where technological uncertainty is low, could reveal different findings. For instance, competence and integrity-based trust may not emerge as key criteria to select suppliers in such contexts. Additionally, affect and competence-based trust may emerge after a history of collaboration with a supplier.

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